

**MECHATRONICS
(MECH 3252)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

Candidates are required to give answer in their own words as far as practicable.

**Group - A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
 - (i) For operating a hydraulic actuator in forward and reverse direction a DC valve shall have
 - (a) 3 ports 3 positions
 - (b) 4 ports 3 positions
 - (c) 2 ports 2 positions
 - (d) 3 ports 2 positions.
 - (ii) A harmonic drive has input and output shafts connected
 - (a) at right angles
 - (b) collinear
 - (c) parallel
 - (d) any of these.
 - (iii) If $R_s = 3k\Omega$, $R_f = 6k\Omega$ then the relation between v_o and v_g in case of a non-inverting amplifying circuit.
 - (a) $v_o = 9v_g$
 - (b) $v_o = 6v_g$
 - (c) $v_o = 3v_g$
 - (d) $v_o = v_g$.
 - (iv) Recirculating ball screw system is used in CNC Machine for
 - (a) reduced friction
 - (b) reduced backlash
 - (c) high accuracy
 - (d) all of the above.
 - (v) For an Op-amp with negative feedback, the output is
 - (a) equal to the input
 - (b) increased
 - (c) fed back to the inverting input
 - (d) fed back to the non-inverting input.
 - (vi) In 1-to-4 demultiplexer, how many select lines are required?
 - (a) 2
 - (b) 3
 - (c) 4
 - (d) 5.
 - (vii) What is another name for one-shot?
 - (a) Monostable
 - (b) Bistable
 - (c) Astable
 - (d) Tristable.

- (viii) The flip-flops which has not any invalid states are
 - (a) S-R, J-K, D
 - (b) S-R, J-K
 - (c) J-K, D, S-R
 - (d) J-K, D.
- (ix) What is the size of internal RAM of an 8051?
 - (a) 4 KB
 - (b) 64 KB
 - (c) 128 bytes
 - (d) 64 bytes.
- (x) Which device of earlier control mechanism is replaced by a PLC?
 - (a) Motor
 - (b) Electromagnetic relay
 - (c) Generator
 - (d) All of these.

Group - B

2. (a) Define a Mechatronics system? Giving example explain a Mechatronics system.
 (b) With neat sketches describe the following transmission mechanism:
 (i) Linear to rotary (ii) Rotary to linear (iii) Rotary to rotary.
(1 + 3) + (3 + 3 + 2) = 12
3. (a) Explain with a pneumatic circuit diagram the sequencing operation of two pneumatic cylinders using pilot operated DC valves.
 (b) Name the different Electrical Drives used in Mechatronic systems. Draw the speed load characteristics of a DC Motor.
6 + (2 + 4) = 12

Group - C

4. (a) Write the differences between open loop system and closed loop system.
 (b) The input to the shown fluid system (fig.1) is q_1 which is the inlet discharge to tank 1. If the objective is to control the fluid level in tank 2, find out the transfer function of the system. R_1 , R_2 are the resistances to the fluid out from tank 1 and tank 2 respectively. h_1 and h_2 are the heights of liquid in tank 1 and tank 2 respectively.

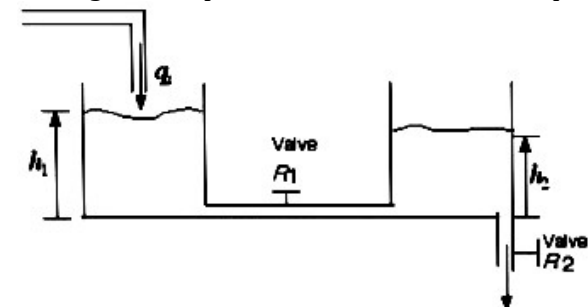


Fig.1

5. (a) Draw equivalent circuit diagram of an op-amp. Write down the characteristics of an ideal op-amp.
- (b) Design a non-inverting amplifier circuit using op-amp to amplify the signal which is coming from a sensor in the range of 0-50mV to an output range of 0-5V. Use minimum of 3k Ω resistance. Assume op-amp to be an ideal op-amp.

$$(2 + 4) + 6 = 12$$

Group – D

6. (a) State De Morgan theorem?
- (b) Simplify the following logic expression using K-map technique.
 $ABC + ABC' + AB'C + A'BC$
7. (a) Explain with diagram the working of a shift register for 4-bit serial input-parallel output using D-flip flop.
- (b) Draw the circuit of a astable multivibrator using 555 timer.

$$2 + 10 = 12$$

$$7 + 5 = 12$$

Group – E

8. (a) Draw the architecture of 8051 microcontroller.
- (b) Write a program (In Assembly language) to add two 16 bit numbers 3B7A H and 42E1 H. Place the result in R4 and R5, R4 to hold the LOB and R5 to hold the HOB.
9. (a) What are the roles of input and output modules in a PLC system?
- (b) Write the sequence followed by a PLC System to carry out a program.
- (c) Implement following logic gates in ladder diagram.
 - (i) 3 input NOR gate.
 - (ii) 2 input EX-OR gate.

$$6 + 6 = 12$$

$$4 + 4 + 4 = 12$$